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DYNAMICS OF PLANKTON POPULATIONS
IN UPWELLING AREAS

(E73-10603) DYNAMICS OF PLANKTON
POPULATIONS IN UPWELLING AREAS (Delaware
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INTRODUCTION

In February 1973, Philip Hass participated in a cruise aboard the Spanish vessel "Cornide de Saveedra" off the coast of Northwest Africa. Data collected on this cruise included continuous chlorophyll measurements, pigment determinations, whole water samples for phytoplankton community description and air samples for the atmospheric transport studies.

METHODS

GENERAL: The cruise track and station locations are shown in Figure 1. Eight liter samples were drawn at 0, 10, 20, and 50 meters for each of the 29 stations for pigment determinations and phytoplankton community description.

CONTINUOUS CHLOROPHYLL: Chlorophyll a at the 10 m. depth was continuously monitored throughout the cruise with a Turner III fluorometer in conjunction with a Beckman VOM5 recorder. Calibration of the system was made using the standard method of discrete sampling described below.

PIGMENT ANALYSIS: Five liters of sea water were taken from the 8 liter sample bottle and filtered over a Whatman GF/C 4.25 cm. using Bernoulli suction. The sample along with six milliliters of 90% acetone was put in a screw cap test tube, sonified in the dark

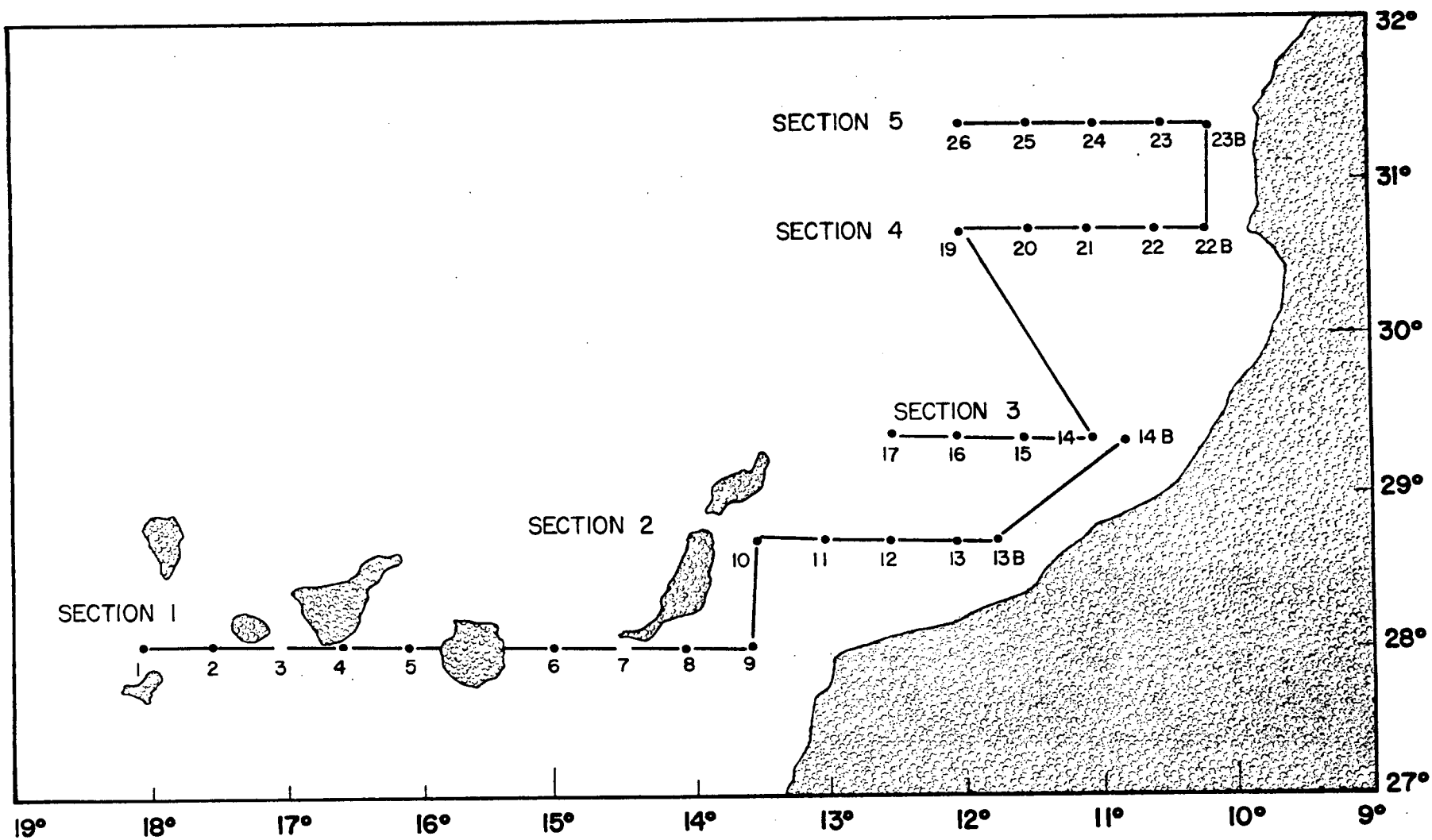


FIGURE I

at 50,000 cps in a Bransonic 220, and placed in the dark at 0°C for 24 hours. After the elapsed time, the sample was removed from the freezer, allowed to warm up, and subsequently centrifuged at 3500 rpm in an Hettich Universal II for 10 minutes.

Absorbance was read against an acetone blank at 750,665 and 430 nanometers using a Beckman DU-2. Equations used for calculating chlorophyll and Margalef's pigment ratio* are given below.

$$\text{Chlorophyll a (micrograms/liter)} = 11.9 \cdot (D_{665} - D_{750}) \cdot (V / (P \cdot VOL))$$

$$\text{Margalef's Pigment Ratio} = \frac{D_{430} - (F \cdot D_{750})}{D_{665} - D_{750}}$$

D750, D665, D430 - optical density at specified wavelengths

V - acetone extraction volume in milliliters

P - path length of cuvette in centimeters

VOL - sample volume in liters

F = 4.0, turbidity correction factor at 430 nm
(Strickland and Parsons, 1972)

Margalef's pigment ratio is an index used to assess photosynthetic pigment diversity and can indicate community structure of phytoplankton populations.

PHYTOPLANKTON SAMPLES: 123 ml of whole seawater was preserved with 2 ml of Lugol's solution in brown glass bottles. The samples were then settled for 24 hours, followed by concentration to 40 ml, and shipped to Delaware for microscopic examination.

HYDROGRAPHIC DATA: Standard hydrographic casts for temperature, salinity, and nutrients were made as well as secchi disk measurements. A preliminary exchange of data has given us the temperature and secchi disk observations given in Tables 3 and 4.

ATMOSPHERIC TRANSPORT: Methods and measurements of samples collected have been reported in the April report.

PRELIMINARY RESULTS

1. Chlorophyll a concentrations measured by discrete sampling at all stations and depths are recorded in Table I. The range encountered covered from 0.19 to 0.84 micrograms per liter. Continuous recordings revealed gentle gradients in concentration over the region surveyed. The highest values recorded for chlorophyll were found at the nearshore stations and associated with lower temperature upwelling water, Table 3.

An example of computer mapping techniques is shown in Figure 2. This is a vertical profile, 0-50 m, of Section 5 showing an increase in chlorophyll concentrations represented by increasing print density, from the Canary Current to a zone of upwelling along the coast.

2. Margalef's pigment ratio, Table 2, varied from 3.09 to 12.53 with most of the values occurring between 3 and 4. Microscopic examination of the samples will reveal the utility of this index for describing biological structure.

3. Preliminary microscopic examination of the phytoplankton samples indicates that the region surveyed is characterized by flagellates, rarely exceeding 30 micrometers in the largest dimension, supplemented with a few larger diatoms. Counting and analysis is continuing to obtain more qualitative and quantitative information in the phytoplankton of this region.

4. Further analysis regarding the response of phytoplankton in this area to the nutrient and hydrographic environment using regression analysis techniques will follow upon completion of the exchange of data.

SUMMARY

FIGURE II

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TABLE 1

Chlorophyll ($\mu\text{g/l}$) micrograms/liter

Station	Depth (m)				
	0	10	20	50	Avg.
1	0.47	0.56	0.56	0.67	.57
2	0.19	0.21	0.20	0.50	.28
3	0.24	0.23	0.23	0.29	.25
4	0.49	0.36	0.26	0.53	.41
5	0.47	0.50	0.56	0.54	.52
6	0.57	0.64	0.59	0.63	.61
7	0.44	0.39	0.40	0.41	.41
8	0.34	0.41	0.39	0.37	.38
9	0.54	0.60	0.69	0.34	.54
10	0.34	0.49	0.54	0.37	.44
11	0.56	0.63	0.59	0.53	.58
12	0.56	0.59	0.57	0.57	.57
13	0.40	0.43	0.63	0.46	.48
13B	0.47	0.51	0.63	0.51	.53
14B	0.54	0.60	0.84	0.30	.57
14	0.58	0.66	0.70	0.63	.64
15	0.56	0.59	0.64	0.54	.58
16	0.55	0.64	0.62	0.56	.59
17	0.56	0.60	0.63	0.56	.59
19	0.50	0.53	0.63	0.54	.55
20	0.47	0.53	0.57	0.53	.52
21	0.50	0.43	0.56	0.51	.50
22	0.43	0.41	0.49	0.45	.44
22B	0.39	0.47	0.56	0.51	.48
23	0.45	0.44	0.45	0.45	.45
23B	0.79	0.77	0.63	0.79	.74
24	0.46	0.40	0.39	0.42	.42
25	0.51	0.50	0.53	0.49	.51
26	0.34	0.43	0.47	0.39	.41

TABLE 2
Margalef's Pigment Ratio (D430/D665)

<u>Station</u>	<u>0</u>	<u>Depth (m)</u>			<u>Avg.</u>
		<u>10</u>	<u>20</u>	<u>50</u>	
1	3.67	3.90	3.54	2.87	3.50
2	4.15	4.40	3.50	3.57	3.90
3	12.53	7.88	4.81	4.85	7.52
4	3.85	4.08	6.39	2.68	4.25
5	3.82	3.91	3.92	3.66	3.83
6	3.78	3.67	3.83	4.14	3.86
7	3.39	3.70	3.79	3.93	3.70
8	4.13	3.83	5.26	4.08	4.32
9	3.68	3.50	3.65	3.96	3.70
10	3.50	3.68	3.61	3.38	3.70
11	3.28	3.79	3.63	3.73	3.61
12	3.36	3.54	3.50	3.50	3.47
13	3.79	3.37	3.34	3.63	3.53
13B	3.27	3.11	3.30	3.72	3.35
14B	4.03	3.79	3.59	4.33	3.94
14	3.94	3.63	3.59	3.65	3.70
15	3.71	3.63	3.57	3.64	3.64
16	3.77	3.31	3.28	3.84	3.55
17	3.31	3.57	3.59	3.84	3.58
19	3.71	3.57	3.25	4.18	3.68
20	3.63	3.76	3.44	3.74	3.64
21	3.50	3.70	3.16	3.78	3.54
22	3.61	4.03	3.40	3.90	3.74
22B	4.15	3.88	3.51	3.61	3.79
23	3.85	3.97	3.72	4.03	3.89
23B	3.14	3.17	3.09	3.14	3.14
24	3.35	3.89	3.68	3.86	3.70
25	3.49	3.97	3.33	3.67	3.62
26	4.54	4.40	3.70	4.15	4.20

TABLE 3

Temperature (°C) Uncorrected $\pm .05^{\circ}\text{C}$

<u>Station</u>	<u>Depth</u>				<u>Avg.</u>
	<u>0</u>	<u>10</u>	<u>20</u>	<u>50</u>	
1	18.20	18.23	18.18	18.23	18.21
2	18.89	18.89	18.80	18.47	18.76
3	18.81	18.83	18.78	18.82	18.81
4	18.29	18.29	18.26	18.38	18.30
5	18.31	18.31	18.27	18.32	18.30
6	17.73	17.73	16.69?	17.74	
7	17.45	17.47	17.41	17.41	17.44
8	17.28	17.24	17.17	17.15	17.21
9	16.97	16.96	16.98	16.72	16.91
10	17.68	17.24	17.17	17.16	17.31
11	17.47	17.01	16.96	16.69	17.03
12	16.45	16.42	16.38	16.37	16.40
13	16.25	16.26	16.20	16.27	16.24
13B	16.30	16.28	16.27	16.27	16.28
14B	16.81	16.55	16.52	16.44	16.58
14	16.23	16.23	16.20	16.19	16.21
15	16.43	16.35	16.42	16.45	16.41
16	16.57	16.57	16.54	16.57	16.56
17	16.38	16.38	16.37	16.40	16.38
19	16.58	16.58	16.56	16.56	16.57
20	16.31	16.34	16.31	16.36	16.33
21	16.36	16.39	16.34	16.39	16.37
22	16.24	16.25	16.27	16.28	16.26
22B	15.50	15.51	15.49	15.46	15.49
23B	15.45	15.47	15.47	15.49	15.47
23	15.94	15.96	15.94	15.96	15.95
24	16.75	16.76	16.72	16.74	16.74
25	16.78	16.77	16.75	16.77	16.77
26	16.54	16.54	16.52	16.57	16.54

TABLE 4
Secchi Depth

<u>Station</u>	<u>Secchi Depth</u>
1	15 m.
2	16 m.
5	21 m.
9	20 m.
11	15 m.
13B	16 m.
14B	16 m.
14	14 m.
17	12 m.
22B	9 m.
23B	9 m.
26	18 m.